U. S. Department of Agriculture
Bureau of Agricultural Chemistry
and Engineering
Division of Farm Mechanical Equipment Research

Care of Rubber Tires on the Farm

Rubber in ever-increasing quantities has been going into farm machinery and equipment, the greater part into tires for tractors with less amounts for motor trucks, trailers, and other farm rolling equipment. The present crude rubber shortage, however, resulting in restrictions for non-military uses will be felt in both new manufactures and in the replacement needs.

Owners of rubber-tired equipment can materially delay the uncertainties and difficulties of obtaining new tires by making their present ones last longer. To this end, authoritative information has been assembled bearing on different angles of tire care and repair - some insuring years of extended service.

Pressures

The first consideration in rubber tire maintenance is proper inflation at all times. Below are given air pressures for farm tractor and implement tires recommended by The Rubber Manufacturers Association, Inc., and adopted by the Tire and Rim Association.

Farm Tractors
Front Tires - All Sizes

4-ply tires	28 lbs.
6-ply tires	36 lbs.

Rear Tires - All Sizes*

Minimum inflation pressure	12 lbs.
When plowing, increase pressure in tire on furrow wheel by	4 lbs.

When special heavy wheels are used, or when heavy implements, such as corn pickers, bedders, etc., are carried on the tractor, inflation pressure must be increased.

(See dealer or manufacturer's instructions.)

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* Exceptions are the small section dual tires which require a minimum of 20 lbs.

Farm Implements

Tire Size	Air Pressure			
(All Rim Diameters)	4-ply	6-ply	8-ply	10-ply
	Lbs.	Lbs.	Lbs.	Lbs.
3.00	44			
3.50	40	48		
4.00	36	48		
5.00, 5.50	32	44		
6.00, 6.50, 7.00	28	40	56	
7.50, 8.00	24	36	48	
9.00	20	32	44	56
11.25	--	28	36	44
12.75	--	24	32	

Figures shown in the tables are minimum pressures below which, to prevent cuts and breaks and inefficient operation, tires should not be operated.

Repairing

Rubber tires on agricultural machines, especially tractors, are subject to cuts by sharp objects and damage and breaks by impact. There is an additional hazard on rough, stony or newly cleared ground. Here the cautious operator will work his tractor with care as undue slippage causes sharp stones to slash the tires.

Prompt attention to tire damage frequently may prevent more serious damage and expense. In this connection the individual auto tire repair kit will be of considerable service since materials and methods used, especially for emergency treatment, are similar in each case.

Exterior cuts should be washed out clean with gasoline, dried, and filled with rubber cement or other suitable repair material. Nail holes are best mended by the use of rubber plugs inserted from the inside.

Where the inside cord fabric is broken, the break should be first washed out clean with gasoline and dried, then protected with a tire patch adequately covering and extending beyond the affected area and cemented on to prevent slipping out of place. Experience with automobile tire patches should endorse this treatment only as preliminary to a vulcanizing job provided the condition of the tire justifies the expense.

Tires are subject to checking (radial cracking) when exposed to sun and weather, and to continuous excessive air pressure. Normally this condition does not result seriously but when cracking seems worse than usual the air pressure should be checked and the tires painted with some protective coating recommended by a tire dealer. Checks or cracks of appreciable size will admit dirt and moisture resulting shortly in serious damage; they should be filled with rubber cement or other material as the case may warrant.

Recapping

When the original tread of a rubber tire is worn off consideration should be given to furnishing the tire with a strip of new rubber around the periphery of the casing. Retreading of tires has been practiced for a number of years and some of the early experiences were rather disappointing. New and more effective processes have, however, been developed with the result that in 1940 nearly 7,000,000 tires were reconditiond. One of three processes is used - "top capping", "full recapping", or "retreading" - depending upon the tire condition and the amount of rubber left on the tire. Some tires permit several recap jobs. Experience with passenger cars has been that recapping saves about six pounds of rubber per tire, costs 40 to 50 percent as much as a new tire, and gives the motorist 75 to 80 percent of new-tire mileage. Proportional results would be expected from tires for tractors and other farm machinery, and in view of the present rubber shortage the possible saving of rubber in this manner should receive serious consideration. A good recap job calls for expert workmanship. The tire selected for recapping should first be carefully examined to insure that the bead is not broken or badly damaged and that the inside casing is free of breaks and nail holes.

Sooner or later the operator will find it necessary to demount a tire for repair or replacement, and also to mount one. With the possibility of tire change coming at a time when delay and inconvenience would be serious, the proper tools and knowledge of just how best to perform this job should be already on hand. Serious delay and tire injury are possible without it. The method of changing will vary with the type of rim used as indicated in the following instructions for drop-center rims and for semi-drop-center rims.

How to remove tires from drop-center rims.

Full drop-center rims have continuous base and rim flanges and may, or may not, be demountable. The directions given here are for removing tires without removing rim or wheel.

1. While supporting axle on a jack, deflate tire completely by removing valve core. Force outside bead off seat by prying from rim flanges; use tire-iron (Beaver-tail type recommended) and go completely around the tire, forcing it toward center of rim. Repeat on inside bead. If the tire has been mounted for

some time it may be necessary to use two 12" iron C clamps, advancing them alternately, for loosening the tire from rim flanges.

2. Lock wheel while tire valve is at top by putting machine in gear. Force with foot bead at bottom into rim well. Insert tire iron at top and pry the whole outside bead over rim flange, being sure to pry just sufficiently to accomplish this as excessive prying may damage tire bead.

3. If only a puncture is to be repaired, the inner tube can be removed, patched and replaced in casing without removing the latter completely from wheel. In this case thoroughly inspect inside of casing for nails, glass, or any injuries before re-inserting tube. (If only the tube has been removed, it may be replaced while deflated by slipping it under the edge of outer bead after locking wheel while valve hole in rim is at the bottom and then proceeding according to paragraphs 3 and 4 of "How to apply tires on drop-center rims" which follows.)

4. To remove tire completely from wheel, insert tire iron at top under inside bead and pry tire off wheel with iron pivoted on outer flange. Be sure that bottom part of bead, on opposite side, is in the well of rim.

How to apply tires on drop-center rims. (Without removing rim or wheel)

1. Lock wheel while axle is supported by a jack and the valve hole in rim is at the bottom by putting machine in gear. Place tube in casing so valve will face valve hole when tire is mounted to revolve in right direction. Lift tire up on wheel and place inner bead over outer flange and down into rim well.

2. With two tire irons pry remainder of inner bead over rim flange. Take small bites to make prying easy. Then pull valve through hole and hold in place with a conical cup or wire attached for this purpose.

3. Lift top part of outer bead over rim flange and down into rim well. Then proceed to pry remainder of bead over flange.

4. After bead is started, hold top part of bead in rim well with one tool and pry bead over rim flange with the other. Then inflate tube, making sure that beads are seated properly on rim flanges. Inflate to 30 pounds air pressure to seat tire beads. Then completely deflate to allow tube to take its natural position, and reinflate to recommended air pressure.

Do not use soap on tractor tires and rims to facilitate mounting. This will cause slippage of the tire on the rim. Never use petroleum oil or grease on tire beads or rims - they are injurious to rubber.

How to remove tires from semi-drop-center rims.

Semi-drop-center rims have a solid base with a shallow well; the rim ring is detachable and may consist of either one piece or two pieces.

1. First remove rim with tire from wheel turned so as to have valve-hole up. Then completely deflate tire by removing core from inside of valve stem. Strike side ring with hammer near split to drive tire bead off its seat. If bead is rusted to rim it may be necessary to use tire tool (Beaver-tail type).

2. Use tire tool to remove rim ring. If ring is of one-piece type, insert tool in the notch and pry it off; if it is of two-piece type, pry off the split lock ring, thus permitting the inner ring to slide off.

3. Place 4" block under the tire (not under the rim) at the valve side. Step on tire and force tire bead into well. Insert tool under tire bead near valve and work off outer bead.

4. Turn tire and rim assembly over. Insert tool between the rim flange and tire and work off bead seat. Force inner bead into well and complete removal of tire.

How to apply tires on semi-drop-center rims.

1. Place tire on rim, beginning at the point opposite valve, step on tire and force inner bead down into well. Then walk the outer bead into place.

2. If rim ring is of one-piece type, start to apply it with the hands, placing the driver of ring next to slot in base. Then walk rim ring on. Insert tire tool in the slot at split and force ends into place. If rim ring is of two-piece type, put solid ring in place; then apply split lock ring and force into place with tire tool.

3. Inflate tire partially. Tap rim ring gently to insure proper seating. Inflate to 30 pounds air pressure to seat tire beads. Then completely deflate to allow tube to take its natural position; then reinflate to recommended air pressure.

4. Mount tire and rim on wheel. Keep wheel at same level as rim, adjusting rim height by jacking if necessary, so it will not be necessary to lift tire and rim.

Traction and Tire Wear

Wheel slippage, resulting in tire wear, may be caused by over inflation of tires, insufficient weight on rear axle, or overloading. Slippage will vary considerably with character of ground, being least on dry concrete pavement and greatest on sod. Authoritative tests have shown that greater tractor efficiencies are obtained with wheel slippage under 16 percent in ordinary field work and under 5 percent on pavement. This information is of little significance to the operator unless he knows how his machine is performing and what he can do about it. The method of determining slippage is simple, and possible benefits through better tractor performance with less wear on tires by adjusting tire inflation or adding weight would be well worth the effort.

To determine the wheel slippage, tie a string or rag around a tractor spoke and drive the tractor without implement or load over the ground for 25 revolutions of the drive wheel, and set a stake at each end of the distance traveled. Then hitch the implement or load to the tractor and count the number of revolutions in going the same distance, being sure not to run in the same tracks. The difference in wheel revolutions with and without load, divided by the revolutions necessary with load and multiplied by 100 equals the wheel slippage in percent. Assuming that 25 revolutions are required without load and 30 revolutions with load, to cover the same distance, then 30 minus 25 or 5 revolutions equals wheel slippage in 30 revolutions and $\frac{5}{30}$ x 100 or 16.7 equals slippage in percent.

Ground moisture will affect wheel slippage to a considerable extent. Tire chains or tire lugs are recommended, as the particular case warrants. The dealer has this equipment and can give advice as to solving problems of this nature.

Wheel weights and tire ballast that may have been added for adequate traction in heavy field work should be dispensed with if the tractor is to do much continuous road work. Weighting is not necessary for road or light field work. Operating heavily weighted tractors on pavement, especially at high speeds, will result in loss of much rubber in a short time.

Protect Your Investment

Rubber tires represent a somewhat greater investment than do steel wheels but in return provide more bodily comfort for the operator and greater proven economies to the owner. Maximum service from rubber tires, however, requires care and intelligent handling which, in the face of impending rubber shortage, should be given without limit. Moreover, it might be difficult to replace rubber tired wheels with steel wheels because of curtailment in uses of steel for purposes other than national defense. Consequently any measures tending to prolong the service of our present rubber equipment should be adopted.

Inspect tires at least once a week and remove all embedded stones and other objects from the tread before they work into the tire. When rims become battered and out of shape, demount tire and straighten them or replace flanges on rims if they are detachable and cannot be properly repaired.

All grease and oil should be kept away from rubber tires because of their deteriorating effect. Such contact may happen driving into shop or garage or when filling crankcase with oil. Be sure to wipe any grease or oil from the rubber.

Rubber-tired equipment stored for seasonal periods should preferably be rolled on boards and jacked up to relieve pressure on the tires; in no case should tires be left for a long time in contact with cinders because of the adverse action of the sulfur in cinders upon the rubber. Storage under cover should be provided to keep sunlight off the rubber tires.

Equipment is frequently shipped from the factory with excessive air pressures in tires to minimize bouncing. Be sure to inspect all tires on delivery and adjust to proper pressures.

Mounted tractor tires may be shipped with anti-freeze material in the liquid tire ballast. The presence or absence of such material should at once be determined. All new and old tires containing liquid ballast should be protected during the winter months with anti-freeze material. Calcium chloride is safe and economical for this purpose and can usually be bought from building-supply dealers. The table on pages 10 and 11 shows the amounts necessary for several sizes of tires. In preparing the solution, previous to putting it into the tire, never pour the water over the calcium chloride but add the latter slowly to the proper amount of water. Use calcium chloride economically as its supply is somewhat limited.

Tires are filled usually with solution (or water) by hand force pump or by gravity from an overhead container with wheel turned so that tire valve is at top. An adaptor for this purpose with instructions can be obtained from your tire dealer. In draining tires of solution (or water) stop wheel so that tire valve is at the bottom and remove the valve stem; the weight of the tractor and remaining air pressure in the tire will force most of the liquid out. If anti-freeze solution is to be saved, attach a hose to valve with other end emptying into a container. When calcium chloride is used in tires be sure to clean inside of tire thoroughly before making a repair. Wash the inside first with water; then wash several times with a solution of 1/2 pint of washing soda to 1 gallon of water; then finish washing with water and allow tire to dry.

NEVER USE ANTI-FREEZE SOLUTION CONTAINING CALCIUM CHLORIDE IN RADIATORS AS IT WILL ATTACK THE METAL AND CAUSE LEAKS.

Until the beginner becomes better acquainted with the performance of tractors on rubber tires he would do well to observe all of the rules developed in the interest of safe and efficient operation, with special emphasis on the following:

1. Always drive the tractor at speeds slow enough to insure safety, especially over rough ground or near ditches.

2. Always keep the tractor in gear when going down steep hills or grades.

3. When driving on highways, or to and from fields, be sure that both drive wheels are braked simultaneously when making an emergency stop.

4. Reduce speed before making a turn or applying brakes. The chance of overturning the tractor increases considerably with increase in rate of travel.

5. Always ride on seat or stand on platform of tractor. Never ride on the drawbar or on the drawn implement.

6. Never dismount from the tractor when it is in motion. Wait until it stops.

7. Be sure to ground your tractor at all times to obviate danger of fire from static electricity. Attach a light chain or other metal connector to the drawbar so that the free end will reach the ground.

8. Keep valve caps on all valve stems to prevent entry of dirt and escape of air.

Automobiles and Motor Trucks

Use of the automobile and motor truck about the farm should be attended with unusual care as otherwise the tires may be damaged by road-holes, stones, stumps or other obstructions. Cuts in the tire tread or in the fabric may result especially if the tire pressure is low. It might be worth consideration, where conditions would warrant, to have one vehicle for any "rough" usage of this nature thus saving the tires of other vehicles from possible damage.

Even if you are a careful driver, great saving of tires is possible by eliminating unnecessary trips; plan to consolidate your various individual travel requirements; trade rides and service with neighbors; and where public transportation is available, use it as far as possible.

Moderate speed on highways will do much toward conserving rubber and incidentally cut down accidents. Your tires will last twice as long when driven at 40 miles an hour as they will when driven 60 miles per hour. High speeds heat the tires, causing deterioration and rapid loss of tread.

Considerable rubber is ground off treads in making a quick start, in turning corners at high speed and in stopping quickly. Marks caused by the rubber thus lost are frequently left on the pavement.

Check your tires for proper inflation at least once a week; tire injury in striking curbs or other obstructions increases considerably with low inflation which should be avoided at all times. Where tires are occasionally deflated for increased traction, as on slippery pavement or on soft ground, be sure to inflate tires to proper pressure when such an emergency is past.

Do not forget that truck tires are built for specific loads and that serious damage may result from overloading them. Consult your tire dealer for proper tire pressures and loads.

Tires wear unevenly and excessively when wheels are out of alignment. Where this is apparent from inspection of the tires it should be corrected. It is a good plan, too, to shift tires every 3 or 4 thousand miles of travel to other wheels to prevent uneven wear. One way of doing this systematically would be to place the spare tire on the left front wheel; that from the left front wheel on the left rear wheel; that from the left rear wheel on the right front wheel; that from the right front wheel on the right rear wheel; and that from the right rear wheel on the spare tire holder. In this way each of the five tires occupies each position in turn. If the spare tire is an old one intended for temporary use during emergencies, periodic tire exchanges to equalize wear may be made between left front and right rear wheels, and between right front and left real wheels.

Do not allow a tire, as good or better than those on the wheels, to deteriorate on the spare-tire rim; use it so that constant wear may be had from all five tires.

Inspect your tires frequently for cuts, bruises and breaks. Much can be done to prevent serious tire injury if the minor damage is taken care of. Clean and fill tread cuts with rubber cement or other materials; put temporary patches under fabric breaks and vulcanize, if justifiable, shortly afterwards.

Have smooth tires recapped with new treads provided the casings are in suitable condition; be sure this is done by a reliable shop. The U. S. Army proposes to conserve 50 percent of the rubber used on Army trucks and automobiles by recapping their smooth tires. You, too, must help.

Proper proportions for mixing Calcium Chloride
in order to protect water from freezing

Tire Size	Liquid Capacity with Valve in Top Position		Mixture to Use for 0°			Mixture to Use for -20°		
	Gallons	Pounds	Gallons Water to Use with Calcium Chloride	Pounds Commercial Calcium Chloride to Add	Approx. Weight of Solution in Pounds	Gallons Water to Use with Calcium Chloride	Pounds Commercial Calcium Chloride to Add	Approx. Weight of Solution in Pounds
FOR CONVENTICNAL TYPE TRACTOR TIRES								
6.00-22	7	60	7	9	70	7	14	75
6.50-32	13	110	12	15	115	12	24	125
6.50-40	15	125	15	19	145	14	28	145
7.00-24	11	90	11	14	105	11	22	115
7.00-40	18	150	17	21	165	16	32	165
7.00-22	11	90	11	14	105	11	22	115
7.00-24	13	110	12	15	115	12	24	125
7.00-32	15	125	15	19	145	14	28	145
7.00-36	18	150	17	21	165	16	32	165
7.00-40	20	170	19	24	185	18	36	185
8.25-36	20	170	19	24	185	18	36	193
8.25-40	24	200	23	29	220	22	44	227
9.00-24	18	150	17	21	165	16	32	170
9.00-28	20	170	19	24	185	18	36	193
9.00-36	26	220	25	31	240	24	48	250
9.00-40	29	240	27	34	260	26	52	270
10.00-36	39	325	37	46	355	35	70	365
10.00-40	42	350	40	50	385	38	76	397
10.00-44	45	375	43	54	415	42	84	437
11.25-24	30	250	28	35	270	26	52	270
11.25-28	34	285	32	40	310	30	60	318
11.25-36	43	360	41	51	395	39	78	400
11.25-40	46	385	44	55	425	42	84	437
12.75-24	41	345	39	49	375	38	76	397
12.75-28	45	375	43	54	415	41	82	425
12.75-32	50	420	47	59	455	45	90	465
13.50-24	45	375	42	53	406	40	80	415
13.50-28	50	420	47	59	455	45	90	465
13.50-32	55	460	52	65	500	49	98	510

Proper proportions for mixing Calcium Chloride
in order to protect water from freezing

Tire Size	Liquid Capacity with Valve in Top Position		Mixture to Use for 0°			Mixture to Use for -20°		
	Gallons	Pounds	Gallons Water to Use with Calcium Chloride	Pounds Commercial Calcium Chloride to Add	Approx. Weight of Solution in Pounds	Gallons Water to Use with Calcium Chloride	Pounds Commercial Calcium Chloride to Add	Approx. Weight of Solution in Pounds
FOR WIDE-BASE TRACTOR TIRES								
7-32	11	90	10½	13	100	10	20	102
8-24	12	100	11	14	105	11	22	113
8-28	13	110	12	15	115	12	24	125
8-32	15½	130	14½	18	140	14½	29	148
8-36	17	140	16	20	155	15½	31	159
9-24	15½	130	14½	18	140	14½	29	148
9-28	18	150	17	21	165	16	32	170
9-36	22½	190	21½	27	205	20½	42	215
9-38	24½	205	23	29	220	22	44	232
9-42	27	225	26	33	240	25	50	255
10-24	20	170	19	24	185	18	36	193
10-28	24	200	23	29	220	22	44	227
10-36	30	250	28	35	270	27	54	283
10-38	31	260	29	36	280	28	56	295
11-28	33½	280	31	39	300	30	60	318
11-36	39½	330	37	46	355	36	72	374
11-38	41½	350	40	50	385	38	76	397
13-28	44½	375	43	54	415	41	82	425
15-28	69	580	66	83	640	63	126	658
FOR DUAL TIRES								
All Quantities for 2 Tires for 1 Wheel								
4.50-40	15	125	13	17	...	13	26	...
4.50-44	16	135	16	20	...	15	30	...
5.00-40	17	145	17	21	...	16	32	...
5.00-44	19	160	18	23	...	17	34	...
5.50-40	20	170	19	24	...	18	36	...
5.50-44	21	180	20	25	...	19	38	...

For protection to + 20° F. use 1/2 lb.; for 0° F. use 1-1/4 lbs. chloride per gallon of water.

For protection to -20° F. use 2 lbs.; for -40° F. use 2-3/4 lbs. chloride per gallon of water.